

The cohesive end of the lambda genome is known as the

- A. *att*
- B. *cos*
- C. *xis*
- D. *ori*
- E. *int*

Which of the following words or phrases is not associated with conjugation?

- a. "Rolling circle replication"
- b. F (fertility) plasmid
- c. Hfr strains
- d. "Minute" designations on a chromosome
- e. Electroporation

Assume that the *manA* gene, required for metabolism of the sugar mannitol, is regulated by a mechanism involving an inducer:activator complex where mannitol is the inducer. Which of the following statements is true?

- a. Binding of mannitol to the activator turns on transcription of *manA* as the complex stimulates RNA polymerase to bind near the start of the gene.
- b. Binding of mannitol to the activator turns off transcription of *manA* as the complex stimulates RNA polymerase to bind near the start of the gene.
- c. Binding of mannitol to the activator turns on transcription of *manA* as the complex causes RNA polymerase to dissociate from near the start of the gene.
- d. Binding of mannitol to the activator turns off transcription of *manA* as the complex causes RNA polymerase to dissociate from near the start of the gene.
- e. Mannitol induces diauxic growth when used as the sole carbon source.

GroE and GroL work together as a "chaperonin" to:

- b. Properly fold RNA molecules into their final three-dimensional shape.
- c. Promote coupled transcription-translation by stabilizing polysomes.
- d. Target proteins to their correct location (e.g., cytoplasm, periplasm, extracellular space).
- e. Assist in protein folding.
- f. Stabilize interactions between the primase, DNA polymerase I, DNA polymerase III, and ligase that are needed for synthesis of the lagging strand.

Which of the following would **not** be a favorable trait for a prokaryotic expression vector?

- A. Low copy number of the desired gene
- B. Strong transcriptional promoters
- C. Presence of a bacterial ribosome binding site
- D. Proper reading frame and codon usage
- E. Easy detection of inserts

Secondary metabolite refers to

- A. a 19th century religious sect
- B. products formed as a consequence of the inactivation of antibiotics
- C. products formed during the respiration of primary metabolites
- D. substrates consumed after primary ones have been consumed
- E. metabolites produced during stationary phase

In the biosynthesis of penicillins, the type of penicillin produced can be controlled by

- A. The addition of specific precursors to the growing culture and chemical modification after isolation
- B. Changing the growth stage and limiting the concentration of the primary carbon source
- C. Removing all glucose from the growth medium so that there can be no catabolite repression
- D. Maintaining the culture at mid exponential phase and inducing atypical production with the addition of exogenous antibiotics

- E. Growing the culture in a biphasic system so that excreted penicillin will be concentrated in the organic phase thus removing it from the aqueous phase

Which of the following is not considered a cloning vector?

- A. bacteriophage
- B. viroids
- C. vaccinia virus
- D. cosmids
- E. plasmids

The antibiotic resistance determinants included in many cloning vectors permit the ____ of cells bearing the vector.

- A. direct enrichment
- B. spontaneous lysis
- C. reverse transcription
- D. development of competence
- E. aggregation

Assume that the *pyrD* gene, required for pyrimidine biosynthesis, is regulated by a mechanism involving a corepressor:repressor complex where pyrimidines act as the corepressor. Which of the following statements is true?

- a. Binding of pyrimidine to the repressor turns on transcription of *pyrD* as the complex binds to the DNA near the start of the gene.
- b. Binding of pyrimidine to the repressor turns off transcription of *pyrD* as the complex binds to the DNA near the start of the gene.
- c. Binding of pyrimidine to the repressor turns on transcription of *pyrD* as the complex dissociates from the DNA near the start of the gene.
- d. Binding of pyrimidine to the repressor turns off transcription of *pyrD* as the complex dissociates from the DNA near the start of the gene.
- e. Transcription depends on whether light is present or not due to the photochemical crosslinking of thymine (a type of pyrimidine).

Several methodologies have been used for the production of vinegar. In the trickle method, ____ are used to provide a _____ for acetic acid bacteria to grow on.

- A. Small pebbles :: surface
- B. Wood chips :: carbon source
- C. Wood chips :: surface
- D. Polystyrene beads :: filtration system
- E. Wood chips :: filtration system

DNA microarrays (or DNA chips) can be used to monitor the cellular concentrations of a large number of specific RNA molecules simultaneously. This technique was used to compare RNA samples from culture #1 grown in minimal medium and in culture #2 grown in a rich medium (e.g., yeast extract). A reasonable outcome from such an experiment is:

- a. The tRNA concentrations are specifically increased in culture #1 over those in culture #2.
- b. The ribosomal RNA concentrations are specifically increased in culture #1 over those in culture #2.
- c. The total mRNA concentrations are elevated in culture #1.
- d. Dozens (or possibly hundreds) of specific RNAs are increased in concentration in culture #1 over culture #2, while a different set of dozens (or 100s) of specific RNAs are decreased in #1 versus #2.
- e. A defined set of specific RNAs will be found at lower concentrations in culture #2 versus culture #1, and no RNA in culture #2 will exceed the concentration of that RNA in culture #1.

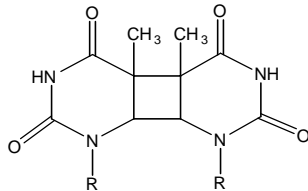
The “promoter sequence”:

- a. Is also known as the origin of replication.
- b. Is recognized by RNA polymerase (plus sigma) as the site adjacent to transcription initiation.
- c. Binds to the 30S subunit of the ribosome (along with other components) as part of translation initiation.
- d. Is needed for synthesizing the RNA primer required for lagging strand synthesis.
- e. Is specifically methylated to prevent digestion by endonucleases.

The sequence of events in a phage infection is determined by the expression of the phage genome. In the case of T7 and T4, two relatively large ds DNA bacteriophage, the infection process is divided into early, middle, and late expression. Early and middle expression usually include genes coding for ____ & ____ while genes expressed late in infection include those coding for ____ & ____.

- A. cell lysis & immunity :: capsomeres and rRNAs
- B. replication & transcription :: head & tail proteins
- C. cell lysis & capsid proteins :: tail fibers & sigma factors
- D. tRNAs & nucleases :: telomerases & proteases
- E. replication & immunity :: lysis & sigma factors

When does one encounter the following chemical structure?



- a. This is known as an “intercalator” that causes DNA polymerase to mistakenly insert an extra base into the newly formed strand at the position of insertion.
- b. This is known as a “base analog” because it closely resembles the structure of guanosine and is mistakenly incorporated into the newly formed DNA for the normal nucleotide, but then base pairs with adenine so causes a subsequent mistake during the next round of replication.
- c. This thymine dimer arises from UV light exposure.
- d. Treatment of cells with this compound enhances their “competence” for DNA uptake.
- e. This chemical causes prophages to excise incorrectly, accounting for specialized transduction, rather than by the normal process leading to typical lytic infection.

A particular mutant strain of *Michiganium stateii* unable to synthesize arginine was serially diluted and plated onto three different media. Medium #1 contained glucose, ammonia, and simple mineral salts. Medium #2 was the same as #1 except that it also contained arginine. Medium #3 was the same as #1, but also contained a purified chemical extracted from the sediment of the Red Cedar River. The results from medium #2 indicated the presence of 2.7×10^7 colony forming units (cfu) per mL of the original culture. In contrast, serial dilution using medium #1 yielded a value of 18 cfu per mL and medium #3 yielded 136 cfu per mL in this original culture. From these results you should conclude:

- a. The compound extracted from the Red Cedar River sediment is used as a growth substrate by *M. stateii*.
- b. Arginine is an inhibitor of growth of this organism.
- c. *M. stateii* is probably green-pigmented.
- d. *M. stateii* contains a prophage and is a lysogenic strain.
- e. Conditional lethality in this microorganism involves a unique temperature dependence.
- f. The purified compound is likely to increase the rate of mutation in this organism (i.e., it is a mutagen).

You wish to use penicillin selection to enrich for cells lacking a functional xylanase gene. These cells would be unable to utilize xylan as a carbon source, but can grow normally with galactose as carbon source. Your experimental protocol is to:

- a. Briefly incubate the cells in medium containing galactose then exchange the medium for one containing xylan plus penicillin. The resulting culture is enriched for the xylanase mutants.
- b. Briefly incubate the cells in medium containing galactose plus penicillin, then exchange the medium for one containing xylan. The resulting culture is enriched for xylanase mutants.
- c. Briefly incubate the cells in medium containing xylan, then exchange the medium for one containing galactose plus penicillin. The resulting culture is enriched for xylanase mutants.
- d. Briefly incubate the cells in medium containing xylan plus penicillin, then exchange the medium for one containing galactose. The resulting culture is enriched for xylanase mutants.
- e. Briefly incubate the cells in medium containing xylan plus galactose, then exchange the medium for one containing only penicillin.

The development of plasmid vectors carrying the polylinker region near or within the gene for beta-galactosidase allows the investigator to quickly determine

- A. if the cell can metabolize maltose

- B. if the cell is resistant to ampicillin
- C. if the plasmid is covalently closed and super coiled
- D. if there is expression of the antibiotic resistant determinants
- E. if the plasmid contains an insert at the polylinker site

According to the information provided in class, *E. coli* devotes approximately what percent of its genome to the combination of replication, transcription, and translation (not including regulation of these processes)?

- a. 1%
- b. 10%
- c. 50%
- d. nearly 100%
- e. The correct answer depends on the codon usage in this microorganism.

Successfully screening for the "correct clone" is a critical step in the cloning procedure. Two techniques are typically used. One uses labeled antibody probes and is dependent on _____ while the other uses labeled nucleic acid probes and is dependent on _____.

- A. protein expression :: Watson-Crick sequence specificity
- B. beta-galactosidase expression :: polymerase activity
- C. absence of proteases :: presence of nuclease
- D. lysed cells :: intact cells
- E. isopropylthiogalactoside :: pixie dust

Important industrial products obtainable from microorganisms include

- A. The cells themselves
- B. Primary metabolites
- C. Secondary metabolites
- D. Enzymes
- E. All of the above

Which statement is incorrect about reading frames?

- a. Any single gene is typically associated with a single reading frame in prokaryotes.
- b. Different genes within a single operon often utilize different reading frames.
- c. Any stretch of DNA has 6 possible reading frames.
- d. A single section of bacterial DNA typically encodes several proteins in different *overlapping* reading frames.
- e. An open reading frame (ORF) is a DNA sequence that encodes no stop codons in that reading frame.

Shortly after mixing a solution of bacteriophage with a suitable host, the number of free phage particles in solution goes down. This is because

- A. The bacteria have denatured the phage
- B. The phage have adsorbed to the bacteria to begin the infection
- C. The bacteria have caused the phage to clump and precipitate
- D. The phage have all stuck to the walls of the flask
- E. Pipetting causes the phage particles to burst and die.

For an ongoing project, you need to amplify the following 500+ base pair gene sequence from a soil bacterium that you have in culture using the polymerase chain reaction (PCR). Note that only the sequences at the termini of the 500+ basepair region are shown.

5' -AGAGTTTGATCCTGCCTACATGGGGCTTTACACG-500bp-TGGCCAAATATATGTCGTGCGCACACGCGC-3'
 3' -TCTCAAACCTAGGACGGATGTACCCCGAAATGTGC-500bp-ACCGGTTTATATACAGCACGCGTGTGCGCG-5'

To that end you isolate genomic DNA from the organism and synthesize two 15 base primers to use in the amplification. A suitable primer pair for this PCR amplification is

- A. 5' -AGAGTTTGATCCTGC and 3' -TCTCAAACCTAGGACG
- B. 3' -TCTCAAACCTAGGACG and 3' -CGCGCACACGCGTGC
- C. 5' -GCGCGTGTGCGCACG and 3' -CGCGCACACGCGTGC

- D. 5'-AGAGTTTGATCCTGC and 5'-GCGCGTGTGCGCACG
 E. any of the above

Selected fragments derived from *EcoRI* and *HindIII* digests are shown below. Note that both of these restriction enzymes leave "sticky ends".

EcoRI fragments:

5' -AATTC**CAAGCTT**CGG-3'
 3' -GGTTC**GAA**GCCTTAA-5'

5' -AATTC**CGCGCC**CGG-3'
 3' -GCGCC**GGCGCTT**AA-5'

HindIII fragments:

5' -AGCTT**GAATTC**GAATTCA-3'
 3' -AACTT**AAGCTT**AAGTTCGA-5'

5' -AGCTT**CGGAATTC**A-3'
 3' -AAGCCT**TAAGTTC**GA-5'

Sequence overlap information can be used to deduce which larger contiguous sequence?

- a. 5' -AATTC**CAAGCTT**CGGAGCTTGAATTCGAATTCA-3'
 3' -GGTTC**GAA**GCCTCGAACTTAAGCTTAAGTTCGA-5'
- b. 5' -AATTC**CGCGCC**CGAGCTTGAATTCGAATTCA-3'
 3' -GCGCC**GGCGCT**CGAACTTAAGCTTAAGTTCGA-5'
- c. 5' -AATTC**CAAGCTT**CGGAATTCA-3'
 3'-GGTTC**GAA**GCCTTAAGTTCGA-5'
- d. 5' -AGCTT**GAATTC**GAATTCGAAGCTTCGG-3'
 3' -AACTT**AAGCTT**AAGTTCGAAGCCTTAA-5'
- e. 5' -AGCTT**CGGAATTC**AAGCTTCGG-3'
 3' -AAGCCT**TAAGTTC**GAAGCCTTAA-5'

Three general methods of gene transfer were discussed in class. Show that you know which is which by indicating the correct order for: the method utilizing a virus (phage), for uptake of naked DNA, and for the process requiring pili.

- a. transformation, transduction, and conjugation
 b. conjugation, transformation, transduction
 c. transduction, transformation, and conjugation
 d. conjugation, transduction, transformation
 e. transduction, conjugation, transformation

Rho-dependent termination is one mechanism for cessation of:

- a. DNA replication on the leading strand
 b. DNA replication on the lagging strand
 c. RNA primer synthesis for lagging strand DNA replication
 d. Translation
 e. Transcription